

2007 SUSPENSION

Wheel and tires - SI Techniques - Cooper

36 WHEEL AND TIRES

KINEMATIC DIAGNOSIS SYSTEM AND ENVIRONMENT

BMW KDS (Beissbarth)



R32 0243

Fig. 1: BMW KDS (Beissbarth)

Courtesy of BMW OF NORTH AMERICA, INC.

1. Foreword

1. Objectives

Wheel alignment has become an increasingly complex subject. The aim of this BMW Service Technology bulletin, therefore, is to achieve several objectives:

- Creation of guidelines for working with the BMW Kinematic Diagnosis System (KDS).
- Familiarization with wheel alignment technology for current vehicles and clarifying any questions which arise in this connection.

- Transparency and clarification of different terms.
- Clarification of the causes of errors in the past, such that they can be avoided after reading this document.
- Creation of conditions for dealing safely with the BMW KDS.

2. Further development of the BMW Kinematic Diagnosis System

- The BMW Kinematic Diagnosis System is an integrated part of automotive system concepts. It ensures that work is carried out in a particularly rational manner which is appropriate for BMW requirements, such that you can also be certain of being prepared for future technological developments. As far as precision and performance in wheel alignment and tuning is concerned, BMW, together with leading manufacturers, has made the best of what is technically feasible: the BMW Kinematic Diagnosis System.
- The BMW Kinematic Diagnosis System manufactured by Beissbarth is more than just the further development of conventional wheel alignment equipment. It sets new standards in precision, performance, speed and handling. It is a guarantor for the perfection which BMW service customers rely on.
- Ride comfort, road safety and tire wear depend to a large extent on the perfect interplay of the vehicle's kinematic functions. BMW is constantly launching new generations of chassis which are even better than their predecessors. This is why there are fewer kinematics system adjusting points and narrower tolerances when measuring and tuning the chassis.
- With the use of the multi-link rear suspension and the E36, the electronic wheel alignment devices are no longer suitable for BMW wheel alignment purposes. This applies to both the measuring procedure and measuring precision. The generation of equipment which was approved with the E36 series still fulfils all the requirements placed on a modern wheel alignment device, including the use of the latest computer technology.
- Only BMW Kinematic Diagnosis Systems manufactured by Beissarth and Bosch may be used for wheel alignment.

3. Technical Data



Fig. 2: Displaying Technical Data On BMW Kinematic Diagnosis Systems
 Courtesy of BMW OF NORTH AMERICA, INC.

TECHNICAL DATA DESCRIPTION CHART

1. Display	○ 17" graphic screen with high-resolution graphics (640x480 pixels with 256 colors)
2. On-screen text	○ in the appropriate national language
3. Wheel dimensions	○ 12"...20"
4. Vehicle memory locations	○ unlimited
5. Rotating plates	○ Loadbearing capacity 1000 kg, angle of rotation $\pm 360^\circ$, 450 x 450 x 50 mm (L x W x H), sliding range ± 50 mm, weight 18 kg
6. Sliding plates	○ Loadbearing capacity 1000 kg, angle of rotation $\pm 10^\circ$, 450 x 450 x 50mm (L x W x H), sliding range ± 65 mm, weight 17 kg
7. Electrical connection	○ 100...115 V / 220...240 V 50/60 Hz, 0.5 kW (other connections on request)

4. Scope of delivery

- 1 PC display device with graphic screen, graphical tablet, small or large equipment cabinet including automatic charging station, DIN A4 dot matrix printer
- 4 Measuring sensors with CCD camera technology and infrared data transmission with built-

in power supply

1 Cable set (comprising 4 cables)

1 Brake clamping device

1 Steering lock device

2 Electronic precision rotating plates with integrated sensor without access ramps

2 Sliding plates without access ramps

4 BMW quick-clamping units, comprising a P8-68 locating bell and P267 01 quick-acting clamp including coated holding claws

1 Operating instructions for BMW KDS (8 languages)

1 BMW software and the BMW vehicle setpoint data with setting screens as well as text for the measurement preparations

5. Accessories required

2 Locating rods for positioning the vehicle

1 Set of sand bags for the prescribed loading

6. Accessories recommended

4 Quick-clamping units

2 Sets of access ramps

1 Remote control / display

1 Trolley (for ballast bags, rotating and sliding plates and 4 quick-acting clamps)

2. Measuring options using the BMW Kinematic Diagnosis System

1. Front axle

- Toe-in (single and total toe-in in relation to the geometrical drive axis)
- Camber (with steering wheel pointing straight ahead)
- Wheel displacement (in relation to the left-hand front wheel)
- Castor, kingpin inclination and toe-differential angle

2. Rear axle

- Toe-in (single and total toe-in in relation to the longitudinal center plane of the vehicle--> previously called symmetrical axis)
- Geometrical drive axis
- Camber

3. Other measuring options

- Rear wheel displacement
- Wheelbase difference
- Lateral displacement on right
- Lateral displacement on left
- Track difference
- Axial displacement

3. System description

1. BMW Kinematic Diagnosis System 1, based on the Beissbarth ML4000

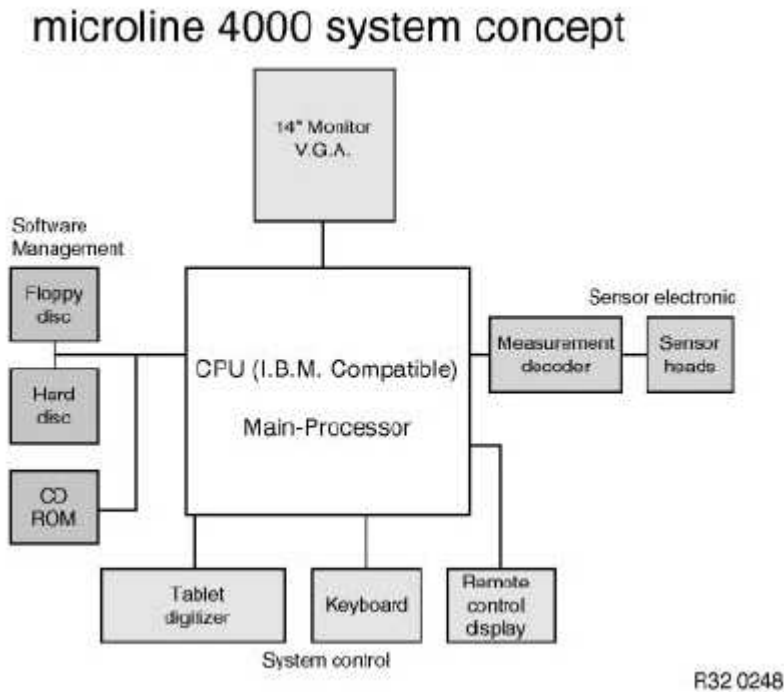


Fig. 3: Microline 4000 System Concept
 Courtesy of BMW OF NORTH AMERICA, INC.

The KDS 1 is available in two different designs at no extra charge:

1. Mobile workstation



Fig. 4: Mobile Workstation
 Courtesy of BMW OF NORTH AMERICA, INC.

2. Mobile compact cabinet



Fig. 5: Mobile Compact Cabinet
Courtesy of BMW OF NORTH AMERICA, INC.

The larger workstation offers a small storage area for accessories, while the compact cabinet is mobile and ideal for restricted working areas. Both variants can be supplied as a cableless measuring system (infrared). From the point of view of measuring technology, there is only a difference in the handling and equipping of the system. For both designs, the four measuring sensors are stored in integrated inserts with rechargeable battery charging points. When automatically charged over night, the measuring sensor batteries provide enough power for 10 hours of continuous use.

2. Computer

- The KDS 1 system comprises tested and reliable industrial components. The computer is an IBM-compatible, 32-bit Intel processor with CD ROM drive to the industry standard.



Fig. 6: Computer
Courtesy of BMW OF NORTH AMERICA, INC.

3. Graphical tablet

- All functions are shown in graphical form on a "pictogram" panel. The panel is protected by

a plexiglass cover. It can easily be replaced if more extensive design modifications are necessary. The operator interface has no membrane and is thus protected against damage. The main functions are activated by clicking the icon with the digital pen.

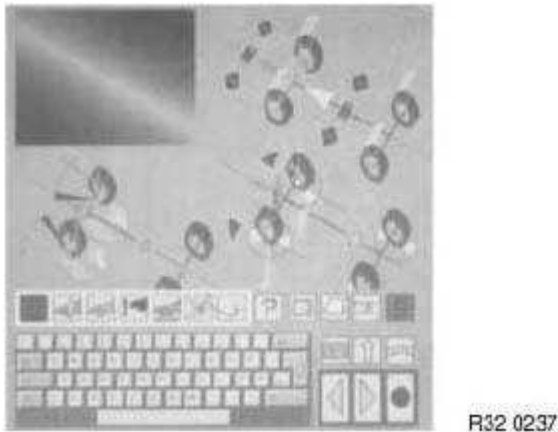


Fig. 7: Graphical Tablet

Courtesy of BMW OF NORTH AMERICA, INC.

4. Equipment cabinet

- The PC with graphic monitor and removable operating panel, supports for the measuring sensors, the remote control and the A4 printer are integrated into the workstation. The charging station is located in the cabinet and can also be connected to the measuring sensors and the remote control using the plug-in cables (operating while simultaneously charging the batteries).

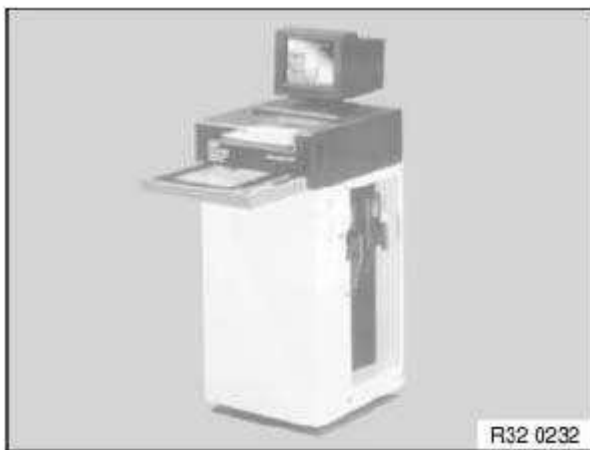


Fig. 8: Equipment Cabinet

Courtesy of BMW OF NORTH AMERICA, INC.

5. Remote display

A cableless remote display can be supplied on request. The remote control keys are only active during measuring and adjustment (not for customer data input, or if selecting a vehicle or editing

the setpoint data etc.). The following displays are supported by the remote control:

- Measured value with setpoint / actual comparison and tolerance bar
- Steering graphics for steering routines
- Live overview of the track / camber values with a setpoint / actual comparison
- Rim run-out compensation



Fig. 9: Remote Display

Courtesy of BMW OF NORTH AMERICA, INC.

6. Measuring sensors with CCD camera

The measuring sensors are each equipped for automatic measurement with two CCD cameras and their own processor for the cableless infrared transmission of data with integrated batteries.

Benefits:

- No temperature deviation
- Very high measuring resolution (the track could theoretically be measured in angular seconds)
- Single track range of more than ± 9 degrees for the constant display of toe-in when changing the tie-rod ends



Fig. 10: Measuring Sensors With CCD Camera
Courtesy of BMW OF NORTH AMERICA, INC.

- Exact system accuracy, i.e. when carrying out measurements at the vehicle following rim run-out compensation, the toe-in and camber measurements are accurate to 2 angular minutes

7. BMW Quick-acting clamp

- BMW quick-acting clamp for holding the measuring sensors precisely in position and measuring without rim run-out compensation.

NOTE: Any existing quick-acting clamps, e.g. from older F1600s or ML-3000s, must not be used on the BMW KDS.

○

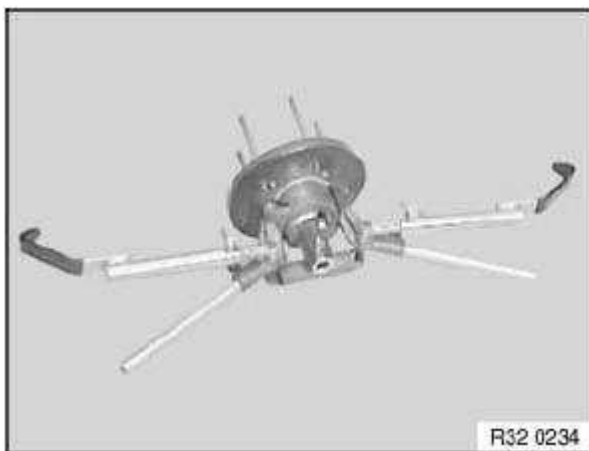


Fig. 11: BMW Quick-Acting Clamp
Courtesy of BMW OF NORTH AMERICA, INC.

8. Rotating / sliding plates

- Electronic precision rotating plates for the front wheels with integrated sensor (360 degree measuring range)

- Stable sliding plates for the rear wheels with a swivelling / rotating top plate
- Accessories: Cover hood for aluminium rotating plates

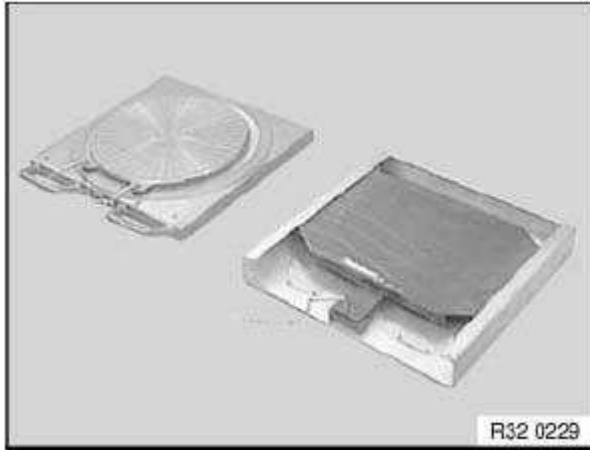


Fig. 12: Rotating / Sliding Plates

Courtesy of BMW OF NORTH AMERICA, INC.

9. Sensor pins

- A new BMW light alloy wheel (styling no. 18) has been available as optional equipment from April 1993. When measurements are being made on vehicles with these wheels, new sensor pins are required for the quick acting clamps of the recommended wheel alignment equipment.
- The new sensor pins are included in the scope of supply for new deliveries of KDS 1 (order number: BS 90 19 11).

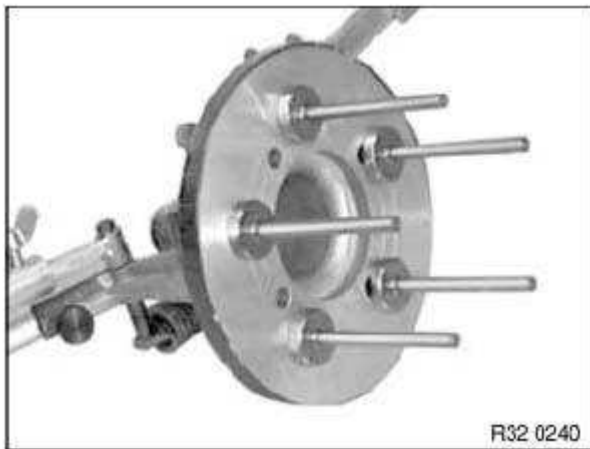


Fig. 13: Sensor Pins

Courtesy of BMW OF NORTH AMERICA, INC.

10. Spoiler adapter

- In the case of vehicles with very low spoilers, the sensor beam may be broken by the spoiler

between the measuring sensors. This primarily occurs in front of the front axle.

- The spoiler adapter is used here as a connecting element between the measuring equipment clamp and the measuring sensor. Thanks to the adapter, the sensors are placed 50 mm lower, thus allowing the sensor beam to move freely below the spoiler.



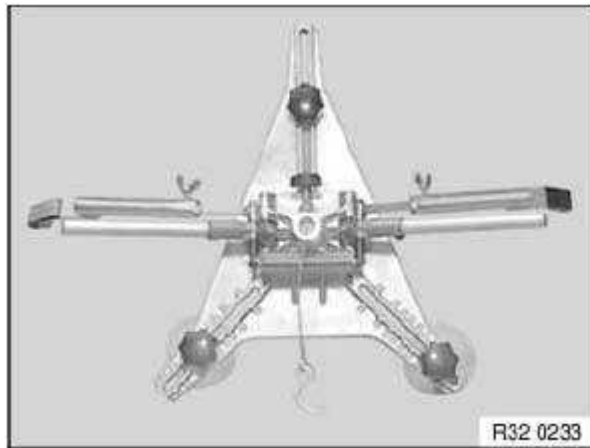
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Fig. 14: Spoiler Adapter

Courtesy of BMW OF NORTH AMERICA, INC.

11. Quick-clamping units

- Quick-clamping units for wheel alignment on non-BMW vehicles with rim run-out compensation.
- Rims without sensors boreholes (rims for BMW vehicles from other manufacturers)



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Fig. 15: Quick-Clamping Units

Courtesy of BMW OF NORTH AMERICA, INC.

12. Retainers

- The most varied clamping options for the measuring equipment are possible thanks to the versatile retainers and the rubber-coated thrust pieces, even on exotic light-alloy rims.



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Fig. 16: Retainers

Courtesy of BMW OF NORTH AMERICA, INC.

4. Workstation

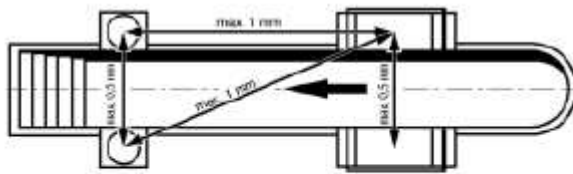
1. Environment

WORKSTATION ENVIRONMENT SPECIFICATION

Description:	Requirements:
All lifting platforms currently recommended by BMW for wheel alignment meet the requirements for the BMW KDS. No particular requirements have to be met in respect of the location at which the BMW KDS is used. The measuring device can be installed over working pits or on lifting platforms.	○ Wheel alignment pits ○ Pillar-type lifts with set-down device ○ 2 plunger-type lifting platforms with set-down device ○ Repair stands with set-down device ○ One measuring area (approx. 4.5 m x 7.0 m). ○ The rotating plates must be pinned to the platform

The support surfaces for the rotating and sliding plates may only display the following maximum height difference:

- from left to right ± 0.5 mm
- from front to back ± 1.0 mm
- diagonally ± 1.0 mm.



R32 Q236

Fig. 17: Displaying Maximum Height Difference
 Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: A difference in the height of the rotary plates of ± 2 mm from left to right results in a measuring error of 4.8° in the camber.
 As a comparison: The camber tolerance on the E36 is $\pm 10'$. The tire tread difference or varying tire pressure cause measuring errors of the same magnitude.

2. Preconditions for alignment

When carrying out the wheel alignment, the front and rear wheels must be centered on the rotating and sliding plates in order that all wheel suspensions remain free of tension during the steering routine and adjustment work. As a result, the rotating and sliding plates for the relevant wheel bases and track widths of the vehicle to be aligned must be moved.

3. Measuring tolerance

All measuring tolerances are system tolerances. This means that the sum of all individual tolerances gives the value shown in the example. Example of camber: Quick-acting clamp + measuring sensor + computer = $1'$ at a measuring range of $\pm 3^\circ$ (all BMW vehicles are within this measuring range).

4. Levelling the measuring station

The manufacturers of the BMW KDS (Beissbarth / Bosch) are able to measure the measuring area to the required accuracy using levelling devices. Any "normal" water level is not suitable for this. Lifting platforms must be levelled under load so that the uneven deflection in the travel rails is taken into account.

IMPORTANT: Adjustment work for the lifting platform concerned must be executed by a specialist (manufacturer's after sales service).

5. Chassis-related terms

1. Toe-differential angle

- The toe-differential angle (a) is the angular position of the internal wheel on the curve in relation to the external wheel on the curve when driving round bends. The steering is designed such that the angular position of the wheels in relation to each other changes as the

steering angle increases.

- In ideal cases, the wheel axes meet at point D in any steering position (except for straight ahead).

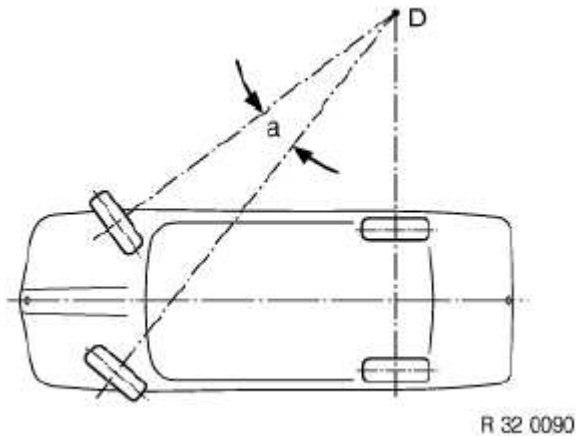


Fig. 18: Toe-Differential Angle
Courtesy of BMW OF NORTH AMERICA, INC.

2. Camber

- The camber is the angle of inclination of the wheel in relation to the vertical.

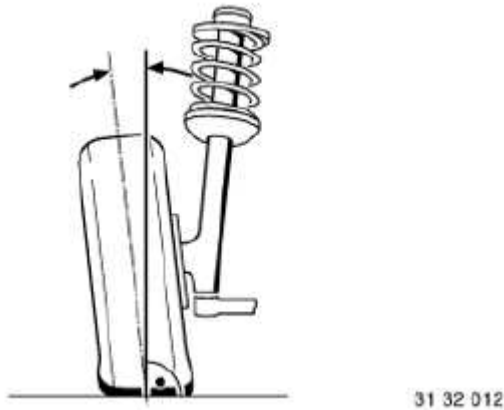
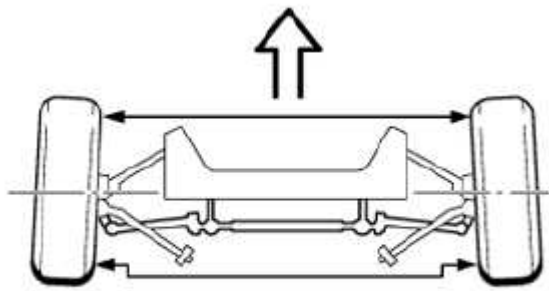


Fig. 19: Camber
Courtesy of BMW OF NORTH AMERICA, INC.

3. Toe-in

- The toe-in is the reduction in the distance between the front of the wheels and the rear. The toe-in prevents the wheels from moving apart while driving (wobbling and grinding).



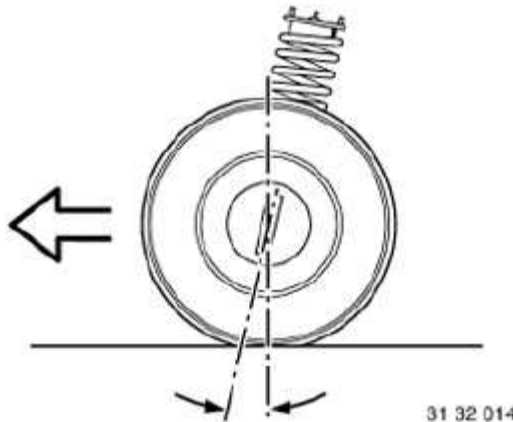
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Fig. 20: Toe-In

Courtesy of BMW OF NORTH AMERICA, INC.

4. Castor

- The castor is the kingpin angle seen from the side in the opposite direction of travel. The line through the center of the spring strut mount and control arm ball joint corresponds to the kingpin.



31 32 014

Fig. 21: Castor

Courtesy of BMW OF NORTH AMERICA, INC.

5. Geometrical drive axis / symmetrical axis

- (1) The geometrical drive axis is the line bisecting the angle of the overall rear wheel toe. The measurements of the front wheels relate to this axis.
- (2) The symmetrical axis represents the center line through the front and rear axes.

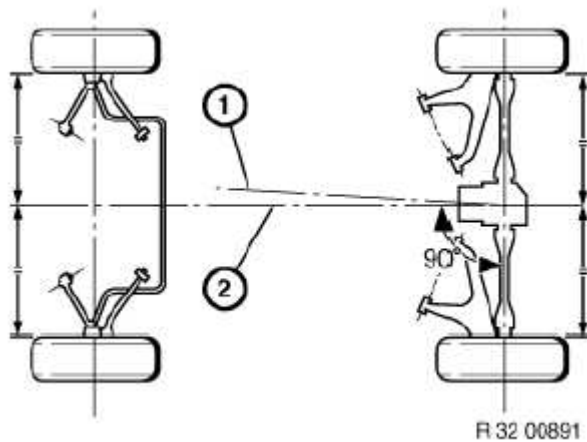


Fig. 22: Geometrical Drive Axis / Symmetrical Axis
Courtesy of BMW OF NORTH AMERICA, INC.

6. Wheel displacement angle

- The wheel displacement angle is the angular deviation of the connecting line of the wheel contact points in relation to a line running at 90° to the geometrical drive axis. The wheel displacement angle is positive if the right hand wheel is displaced to the front, and is negative if it is displaced to the rear.

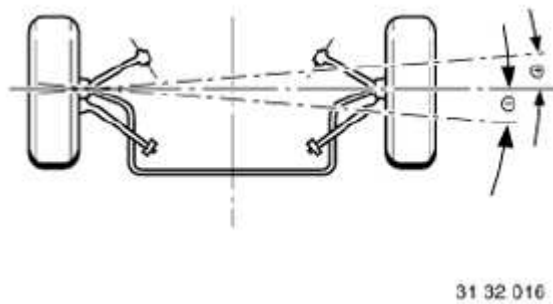
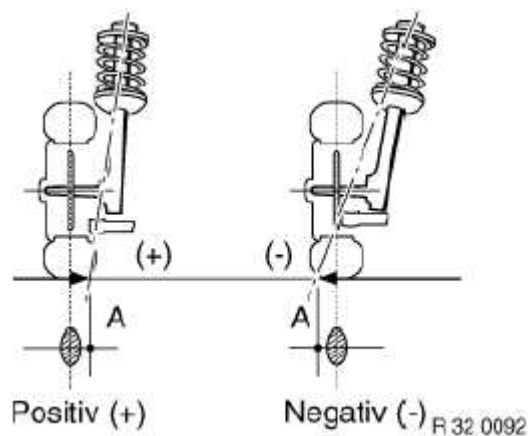


Fig. 23: Wheel Displacement Angle
Courtesy of BMW OF NORTH AMERICA, INC.

7. Kingpin offset

- The kingpin offset is the distance from the center of the wheel contact point to the contact point of the kingpin extrapolation.

**Fig. 24: Kingpin Offset**

Courtesy of BMW OF NORTH AMERICA, INC.

6. Wheel suspension

Those parts which connect the wheel to the mostly load-bearing floor elements of the bodywork and guide it in the required direction belong to the wheel suspension. They are connected by axles or other comparable structures and guided by the arms. The wheel suspension plays a decisive role in the handling characteristics of a vehicle. Two main groups have to be distinguished: 1. Rigid axle suspension and 2. Independent wheel suspension.

1. Rigid axle suspension

RIGID AXLE SUSPENSION SPECIFICATION

Description	Advantages	Disadvantages
The rigid axle suspension has a rigid connection between both wheels or wheel pairs. Any change in one wheel is more or less transferred to the other. It is now only fitted as a rear axle, if at all. However it is frequently used for lorries or busses.	In the event of deflection taking place, there are no changes to the camber or wheel toe. This means: less tire wear and good track stability.	Non-driven rear axles may also acquire negative camber as well as increasing tire lateral guidance, thus increasing tire wear.

2. Independent wheel suspension

INDEPENDENT WHEEL SUSPENSION SPECIFICATION

Description	Advantages	Disadvantages
State-of-the-art individual wheel suspension is available on BMW vehicles on the front and rear axles. This development has its cause in mass inertia, as a reduction in the nonsuspended mass improves wheel and ground contact, and the wheel stays better on the road. Control arms and trailing arms, which have to absorb high longitudinal and lateral forces to some extent, are	Wheels suspended independently from each other have no mutual influence on each other.	Depending on the type, changes may occur in the camber, wheel toe, track width, castor and wheelbase.

required for guiding independently suspended wheels.

7. Wheel alignment / procedure

1. Measuring options

An overview of all measuring options and values (VA = front axle, HA = rear axle) is shown below.

WHEEL ALIGNMENT MEASURING OPTIONS AND VALUES

Measuring options	Measuring accuracy	In measuring range	Total measuring range
Total wheel toe (VA + HA)	± 2'	± 2°	± 18°
Single wheel toe (VA + HA)	± 2'	± 2°	± 9°
Camber (VA + HA)	± 1'	± 3°	± 10°
Wheel displacement (VA)	± 2'	± 2°	± 9°
Geometrical drive axis	± 2'	± 2°	± 9°
Castor	± 4'	± 18°	± 22°
Kingpin inclination	± 4'	± 18°	± 22°
Toe-differential angle	± 4'	± 20°	± 20°
Maximum steering angle (VA)	± 4'	± 60°	± 300°
Maximum steering angle (HA)	± 4'	± 9°	± 9°
Castor correction range	± 4'	± 7°	± 10°

NOTE: The measuring accuracy details only apply when using the precision rotating and sliding plates as well as the BMW quick-acting clamps.

2. Preparatory work

Before commencing the measurement, preparatory work must be carried out at the measuring area and on the vehicle. Preparatory work includes:

- Easy-running rotating and sliding plates
- Aligning the rotating and sliding plates in relation to the track width and wheelbase
- Centering the vehicle on the plates
- Applying the parking brake
- Removing the lock pins on the plates to prevent tension in the chassis under loading
- Checking the rim and tire size, tread depth, tire pressure, steering wheel play, wheel bearings and condition of suspension and shock absorbers
- Fastening the measuring equipment to the wheels
- Loading the vehicle according to BMW KDS specifications
- Rock the vehicle firmly with the brakes released to ensure a stable center position

- Lock the service brake using the brake clamping device

3. Initial / final measurement

This measurement can be carried out as a program-guided measurement in the same way as any subsequent adjusting work and the final measurement. The sequence of the chassis measuring points to be called up is specified and controlled by the system software. The individual steps comprise:

- Driving straight ahead to correctly record the wheel toe and camber values for the rear axle
- Steering routine for recording the castor, kingpin inclination and toe-differential angle
- Recording the wheel toe and camber of the front axle (adjust the steering center point in advance)
- Steering routine for measuring the maximum steering angle on the left/right
- Checking the overview of measured values with the setpoint and actual comparison of all measured values

4. Printing out the data



Fig. 25: Report Printout From Integrated DIN A4 Printer
Courtesy of BMW OF NORTH AMERICA, INC.

The report printout from the integrated DIN A4 printer is subdivided into three sections:

- Header lines with customer and vehicle identification data --> the customer data entered before beginning the measurement as well as vehicle data are printed out here.

- Centre section with vehicle data --> this includes the make, type, model and vehicle model year defined when the setpoint data record was selected. The values previously measured for height level, tire pressure and tread depth are also printed in this section.
- The end section with all vehicle alignment values comprises the 3 columns initial measurement, setpoint values and output measurement. The measured values are recorded separately in these three columns.

8. Special features

1. Free wheel alignment

With free wheel alignment the selection and sequence of the measuring points is freely selectable. The following points must be observed for attaining the correct measurement results:

- Carry out all work in the same way as with the program-guided measurement.
- Before measuring the wheel toe and camber values for the rear axle, the steering must be in the "straight ahead" position to ensure that it is perfectly aligned in relation to the longitudinal center plane of the vehicle.
- Before measuring the single wheel toe values on the front axle, the center of steering must be established to ensure the correct position of the steering wheel.

2. System settings

The following settings must only be entered or set once: language, display format, date/time, advertising text, remote control with display, rotating plate selection and printer settings. They remain stored.

9. BMW Kinematic Diagnosis System comparison (Bosch-Beissbarth)

BMW KINEMATIC DIAGNOSIS SYSTEM COMPARISON (BOSCH-BEISSBARTH)

	Bosch	Beissbarth
Measured value recording	Infrared	CCD camera
Data transmission	Cable	Infrared / cable
Measuring sensor power supply	Cable	Battery / cable
Remote control	Infrared	Infrared
Remote control with measured value display	Cable	Infrared
Setpoint data memory	Floppy disk	Hard disk
Measured value memory	Always the last vehicle measured	Unlimited vehicle memory
Operating system	-	MS-DOS
Languages	English and one language on request	EN, DE, NI, SV, IT, FR, SP (further languages can be called up)
Update	3.5" floppy disk	3.5" floppy disk using TIS/DIS
Monitor	20"	17"
Computer	-	Pentium
Disk drives	2 x floppy disk	1 x floppy, 1 x CD ROM

10. Control modification (menu)

1. Remote control with display

The following steps show how the remote control with display is activated:

1. Call up the **"Service"** menu in special functions ("S" key)
2. Call up the **"Remote control"** sub-menu in the **"Service"** menu.
3. Select the **"Remote control with display"** item in the **"Remote control"** sub-menu - this configuration is retained.

IMPORTANT: In the case of equipment without remote control, this must be configured to "No remote control".

2. Brief operating instructions

1. Activate the remote control with the **"ON"** button (it may also be switched on during alignment). The title page will appear on the LCD.
2. Select **"Straight ahead"** of the **"Initial measurement"** , **"Adjustment work"** or **"Final measurement"** at the measuring equipment cabinet. The steering graphics for **"Straight ahead"** will appear on the LCD.
3. Use the **"Forward arrow"** to change to the next measurement image. Display blocks will appear on the LCD with the designation of the measured value and tolerance bar with the measured value. If the measured value is within the tolerance range, it is shown in dark figures against a light background. If the measured value is outside the tolerance range, it will be shown in inverse video (light figures against a dark background).
4. By pressing the **"F"** key shortly, you can move alternately between the designation of the measured value and the setpoint value with the tolerance inside the display blocks.
5. You can scroll through the measured values using the **"Forward arrow"** , **"Backward arrow"** and **"Cancel" (red dot)** keys. The function of these keys is identical to that of the keys on the graphics panel.
6. Even with **"Free alignment"** , it is possible to scroll through the measured values in the same way as with **"Program-guided alignment"**.
7. During measurement, the report print-out can be initiated using the **"Printer"** key. The remote control keys are only active during measurement and adjustment (not during customer data input, vehicle selection etc.).

3. Display support

- o Measured values with a setpoint/actual comparison and tolerance bar (setpoint figures can be displayed with the **"F"** key)
- o Steering graphics for steering routines
- o Overview of measured values with current setpoint/actual comparison
- o Rim run-out compensation
- o With all other functions (e.g. customer input), the title illustration appears on the LCD display

NOTE: If the data transmission from the remote control to the computer is interrupted, the remote control icon in the bottom right-hand corner of the screen changes color from green to red and the illustration on the LCD display is shown inversely - black turns to white, white to black. This change does not take place in the title illustration. Once the line-of-sight connection has been re-established, the remote control continues to operate from the point of interruption in the program. A continuous visual connection during alignment is therefore not necessary.

- The "**Hour glass**" icon in the LCD display means: "**Please wait**".
- The "**Battery**" icon in the top right-hand corner of the LCD display means that the battery reserve has been reached.
- To switch off the remote control: press the "**F**" key for 5 seconds, then return it to its charging unit or connect it to a charge cable. The title illustration will again appear as a charging check.
- If, during the measurement, the remote control has been placed back in the charging unit, it must be switched on again using the "**ON**" button.

11. Updating the software / setpoint data

Floppy disks will no longer be sent to BMW partners who have acquired a "**BMW KDS** (Beissbarth / Bosch)". For cost-related reasons, you can create these disks yourself on the "**DIS-tester**" or on the "**TIS/EPC server**". The data for this is regularly updated on the TIS CD.

1. Requirements

- BMW KDS (Beissbarth / Bosch)
- TIS CD program status (Beissbarth): from CD 12/95
- EPC program status: from 12/95
- TIS CD program status (Bosch): from CD 08/97
- DIS program status: from V6.0
- 3.5" diskettes, 1.44 MB (Beissbarth 5 diskettes / Bosch 1 diskette)

2. Procedure (Beissbarth)

1. Go to the "Administration" screen
2. Select the **KDS button**
3. Select **Beissbarth**
4. Insert "**Diskette 1**" on request and confirm with "**OK**" (program diskette 1 of 2 is created, label it)
5. Insert "**Diskette 2**" on request and confirm with "**OK**" (program diskette 2 of 2 is created, label it)
6. Insert "**Diskette 3**" on request and confirm with "**OK**" (setpoint data diskette 1 of 3 is created, label it)
7. Insert "**Diskette 4**" on request and confirm with "**OK**" (setpoint data diskette 2 of 3 is created, label it)

8. Insert **"Diskette 5"** on request and confirm with **"OK"** (setpoint data diskette 3 of 3 is created, label it)
9. Perform update and/or setpoint data on the KDS in the usual manner with the diskettes which have just been created.

3. Procedure (Bosch)

1. Go to the "Administration" screen
2. Select the **KDS button**
3. Select **Bosch**
4. Label **"Diskette 3.1"**, insert it into the drive on request and confirm with **"OK"** (2x) --> Setpoint data is copied to the diskettes.
5. Insert setpoint data diskette 3.1 into the 3.1 floppy disk drive, insert operating system diskette 3.0 into the 3.0 drive.
6. Switch on the machine in the usual manner.

IMPORTANT: When creating the KDS diskettes, all data on the diskettes used is overwritten.

NOTE: In the event of an error, a corresponding message is shown and the program is cancelled completely. The procedure must be run from the beginning again and all data on the diskette will be deleted. A new diskette may have to be used.

12. Creating, copying and editing setpoint data

1. Copying

- Press the **"C"** button and select the vehicle to be copied.
- Select the **"Edit setpoint data"** menu item from the special functions. Create a new vehicle in the usual manner. The setpoint values for the last vehicle selected will appear in the data input screen. Enter the data and save the data record.

2. Creating

- Press the **"C"** button and select the **"Edit setpoint data"** menu item from the special functions. Create a new vehicle in the usual manner. An empty data input screen will appear. Enter the data and save the data record.

3. Editing

- Factory-programmed setpoint data can neither be deleted nor modified. If this data does need to be modified, a new vehicle with modified setpoint data must be created. New vehicles created by the user are identified by a **"+"** in the selection menu. These vehicles can be deleted by the user using the **"-"** key or modified using the **"< >"** key. These keys only appear if vehicles have been entered by the user.

13. Special functions

1. Customer-specific printer report header

The sub-item **"Customer-specific text"** must be called up in the **"Special functions"** menu. An

input screen will appear on the monitor. This input screen must be filled out with the name and address and stored with the "S" screen key. The text entered is inserted into the report header.

2. Adjusting options

- Call up the "**Service**" menu in the special functions ("S" key).
- Select the "**Wheel toe adjustment**" item or the "**Camber adjustment**" item from the "Adjustment" sub-menu. The toe and camber adjustment program will guide the user step by step through the adjustment using text and images. The measuring deviation for each measuring sensor will be shown on the screen when the adjustment has been completed.
- You can store the adjustment values in the measuring sensor using the "**Store**" key or you can quit the program with the "**Red dot key**" without saving them (check). The adjustment values can be printed out.

3. Rotating plate test

- Call up the "**Service**" menu in the special functions ("S" key).
- Call up the "**Rotating plate**" item in the "**Service**" menu. Turn the left-hand and right-hand rotating plate and check the display on the screen.

IMPORTANT: The measuring range is ± 306 degrees.

4. Viewing and deleting customer entries from database

- Call up the menu item "**Delete**" in the "**Database**" menu in the special functions. The data input screen will appear. Fill in the search fields with the data to be deleted.
- Use the "-" button to delete this data record. A new data record can then be highlighted and deleted with the digital pen.
- You can scroll through the entire database with the "**Arrow up**" and "**Arrow down**" keys.
- You can quit the delete function by pressing the cancel key (red dot).

14. Modifications within program

Further modifications were carried out within the program which only slightly change the program sequence but which optimize the alignment in respect of comfort and speed. This is described below:

- Optimization of the rim run-out compensation in respect of speed.
- Optimization of the steering routines: Highlighted values within the gate can still be corrected. The message "**Rotating plates not connected**" no longer causes the steering routine to be cancelled. Further measurements can be carried out after the rotating plates have been connected.
- Standardization of screen colors with the colors on the tablet.
- Addition of texts in several foreign languages.
- Elimination of program-related and cosmetic faults.
- Electronic water level.
- Omission of kingpin inclination measurement.

15. Faults

1. Tyre faults

TYRE FAULTS

Fault	Effect
1 Wheel toe, camber, toe-differential angle and castor not correct	1 Severe tire squeaking even at relatively low speeds
2 Excessive toe-in and excessive positive camber	2 Tires are worn down on one outside edge in the longitudinal direction
3 Excessive negative camber	3 Tyre wear on inside edge
4 Worn front-axle suspension on front-wheel-drive vehicles	4 Increased noise / Vehicle pulls on one side when accelerating
5 Incorrect wheel alignment	5 Wheels scrubbing / Tyre surface shows feathering in the tread
6 Play in the suspension due to mechanical parts (suspension, steering)	6 Washout / Wobbling of front wheels
7 Tyre pressure too low	7 Outside tire surface wear

2. Front axle faults

FRONT AXLE FAULTS

Fault	Cause	Remedy
1. Toe deviation	a) Vehicle not in normal position b) Tie rod(s) bent c) Tie rod ball joints worn d) Rubber mount in control arm defective	a) Correct height level b) Replace tie rod(s) c) Replace tie rod(s) d) Replace control arm
2. Camber deviation: The camber is fixed during the design stage and cannot be adjusted.	a) Rubber mount in control arm defective b) Control arm deformed c) Spring strut deformed d) Traction strut worn e) Spring deflection too great f) Front axle carrier deformed g) Spring strut mount deformed h) Distortion in the floor assembly (engine bracket)	a) Replace control arm b) Replace control arm c) Replace spring strut d) Replace control arm e) Replace coil spring, height level f) Replace front axle carrier g) Repair forward structure h) Repair body
3. Castor deviation: The castor is fixed during the design stage and cannot be adjusted.	a) Rubber mount for tension / traction strut defective b) Tension / traction strut deformed c) Control arm deformed d) Spring strut deformed e) Wheelhouse deformed (spring	a) Replace rubber mount b) Replace tension / traction strut c) Replace control arm d) Replace spring strut e) Repair forward structure

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	strut mount)	
	f) Distortion in the floor assembly (engine bracket)	f) Repair body
4. Toe-differential angle deviation	Requirement: camber and castor are correct	
	a) Tie rods unevenly adjusted	a) Set wheel toe on left and right to identical values
5. Wheel displacement deviation	Requirement: Front wheels have same single toe in relation to the geometrical axis	
	a) Front axle carrier deformed	a) Replace front axle carrier
	b) Engine bracket deformed	b) Repair body
	c) Control arm deformed	c) Replace control arm
	d) Tension / traction strut deformed	d) Replace tension / traction strut

3. Rear axle faults

REAR AXLE FAULTS

Fault	Cause	Remedy
1. Camber deviation	a) Vehicle not in normal position: spring deflection too great	a) Correct height level
	b) Rubber mount on rear axle carrier defective	b) Replace rubber mount
	c) Rear axle carrier deformed	c) Check rear axle carrier and replace, if necessary
	d) Control arm deformed	d) Check control arm and replace, if necessary
	e) Traction strut deformed	e) Check traction strut and replace, if necessary
	f) Distortion in the floor assembly	f) Repair body
	g) Swinging arm deformed	g) Replace swinging arm
2. Rear wheel position is not correct	a) Rear axle carrier has been shifted laterally	a) Check the rubber mounts on the rear axle carrier and replace, if necessary
	b) Distortion in the floor assembly	b) Repair body
3. Toe deviation	a) Vehicle not in normal position, i.e. spring deflection too great	a) Correct height level
	b) Rubber mount in rear axle carrier defective	b) Replace rubber mount
	c) Control arm deformed	c) Replace control arm

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4. Deviation from the geometrical drive axis	d) Rubber mount and swinging arm defective	d) Replace swinging arm
	e) Rear axle carrier deformed	e) Check rear axle carrier and replace, if necessary
	f) Traction strut deformed	f) Check traction strut and replace, if necessary
	Requirement: Total wheel toe is correct	
	a) Distortion in the floor assembly	a) Repair body

Further details on the "Kinematic Diagnosis System" can be found in the operating instructions for the BMW KDS (Beissbarth / Bosch).

Functional and system descriptions are not subject to change. Parts availability and immediate ordering availability cannot be derived from this information. The specialist departments will be providing further details at the relevant time.

RUN FLAT INDICATOR

All models



Fig. 26: Run Flat Indicator

Courtesy of BMW OF NORTH AMERICA, INC.

Introduction

The Run Flat Indicator (RPA) monitors the tire pressure throughout the journey.

The entire vehicle weight is carried by the air pressure in the tires. If the pressure in one of the tires should drop, the tire will gradually "cave in". The resulting flexing means that the defective tire will quickly receive additional damage. The tire could burst.

Some 80 % of all flat tires are caused by small holes (e.g. caused by nails). The holes result in a gradual loss of pressure in the affected tire. Many "tire blowouts" can be traced back to preliminary damage caused by a gradual loss of pressure.

A gradual loss of pressure in one tire may remain unnoticed for a long time. The lack of pressure only makes itself clearly felt when driving when the tire is almost completely empty.

As tire pressure drops, the radius of the wheel and with it the tire's rolling circumference will also decrease. The upshot is that the wheel speed of the affected tire is increased.

The RPA records the wheel speeds using the wheel-speed sensors of the Dynamic Stability Control (DSC). The RPA compares the speeds of the individual wheels and computes an average speed. In this way the RPA is able to detect a loss of tire pressure.

The RPA detects a drop in pressure below about $30 \% \pm 10 \%$ of the initial value. The RPA indicator and warning light indicates a drop in tire pressure. The RPA will indicate this after just a short distance, as a rule after a few minutes, from a certain minimum speed (e.g. 25 km/h) up to the permissible top speed.

> Different control units for the Run Flat Indicator

> E46 All-wheel drive

> E46, E53, E83, E85, E86

> E60, E61, E63, E64

> E65, E66

> E70

> E87, E90, E91, E92, E93

> R56

Despite coming from different manufacturers the systems hardly differ from one model series to the next in the way they appear to the driver (initialization, RPA indicator and warning light, characteristics, diagnosis).

IMPORTANT: Responsibility resides with the driver at all times

Check tire pressures regularly, at least twice a month and before embarking on lengthy journeys. During initialization, the set tire pressure is taken as the initial value for the current set of tires.

If all 4 tires loose pressure at the same rate, the wheel speeds will also change at the same rate. The RPA is unable to detect a uniform drop in pressure in all tires (e.g. due to diffusion = natural loss of air from all 4 tires)

IMPORTANT: Correct function of the Run Flat Indicator is not guaranteed when the emergency wheel is fitted.

As the emergency wheel has a much smaller diameter, the correct operation of the RPA can no longer be guaranteed.

Brief description of components

The SMG system comprises the following key components:

- **4 wheel-speed sensors**

The wheel-speed sensors of the Dynamic Stability Control (DSC) measure the wheel speeds of the individual wheels.

- **RPA button**

> E46, E53, E83, E85, E86

The RPA button is only needed for initializing the PRA.

(RPA initialization means "teaching the system the tire pressures").

- **CID: Central Information Display**

Vehicles that are equipped with CID are initialized using the CID.

- **On-board computer button and rocker switch on turn-signal/main-beam switch**

> E87, E90, E91, E92, E93, R56

Initialization is performed on the LCD display, using the BC button and the rocker switch on the turn-signal/main beam switch. The on-board computer functions are selected with the rocker switch.

The R56 does not have a rocker switch. The on-board computer functions are selected with the BC button.

The RPA software is in the following control units, depending on model series:

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- **RPA control unit**

> E46 all-wheel drive

The E46 All-wheel drive has a separate RPA control unit.

The 4 wheel-speed sensors measure the wheel speeds. The DSC control unit sends the signals through 4 direct wires to the RPA control unit.

Alternatively

- **ABS control unit with additional software for Run Flat Indicator**

> R56

The ABS control unit is standard equipment on the R56. RPA is integrated into the DSC control unit by means of additional software.

Alternatively

- **ASC+T control unit with additional software for Run Flat Indicator**

> R56

ASC+T is special equipment on the R56 (ASC+T: Automatic Stability Control plus Traction). RPA is integrated into the ASC+T control unit by means of additional software.

Alternatively

- **DSC control unit with additional software for Run Flat Indicator**

> E46, E53, E60, E61, E63, E64, E70, E83, E85, E86, E87, E90, E91, E92, E93

> R56: Optional equipment

With the DSC Mk60 and DSC 8, the RPA is integrated in the DSC control unit using additional software (The E70 is equipped with DSC 8 Premium).

Alternatively

- **CIM: Chassis Integration Module**

> E65, E66

The CIM controls:

- Servotronic

- Steering column adjustment
- Run Flat Indicator (RPA)

The following control units are involved in the Run Flat Indicator system (in alphabetical order):

○ **CAS: Car Access System**

> E60, E61, E63, E64, E65, E66, E70, E87, E90, E91, E92, E93, R56

The CAS control unit provides input signals relating to terminal status (e.g. terminal 15 ON).

○ **GM: General module**

> E46, E53, E83, E85, E86

The general module provides input signals relating to terminal status (e.g. terminal 15 ON).

○ **JBE: Junction box electronics**

> E70, E87, E90, E91, E92, E93, R56

The JBE is the data interface (= gateway) between the K-CAN and the PT-CAN. (K-CAN stands for "Body Controller Area Network"; PT-CAN stands for "Powertrain Controller Area Network")

The junction box consists of the junction box electronics and the electrical distribution center.

○ **KGM: Body gateway module**

> E60, E61, E63, E64 from 09/2005

The body gateway module (KGM) replaces the safety and gateway module (SGM).

The KGM forms the data interface (= gateway) between the K-CAN and the PT-CAN.

○ **M-ASK or CHAMP or CCC: Multi-audio system controller or multimedia platform or Car Communication Computer**

M-ASK or CCC or CHAMP (multimedia platform: CHAMP; Central Head Unit and Multimedia Platform) issues an acoustic warning through the loudspeakers if the tire pressure should drop.

(On vehicles without M-ASK or CCC or CHAMP, the instrument cluster will emit the warning.)

○ **SGM: Safety and gateway module**

> E60, E61, E63, E64 up to 09/2005

> E65, E66 from 03/2004

The SGM is the data interface (= gateway) between the K-CAN, **byteflight** and the PT-CAN.

- **SZL: Steering column switch cluster**

> E87, E90, E91, E92, E93, R56

The signals from the on-board computer button and from the rocker switch are recorded and processed in the SZL. The data is transmitted to the instrument cluster (on-board computer).

- **ZGM: Central gateway module**

> E65, E66 until 03/2004

The ZGM forms the data interface (= gateway) between the K-CAN and the PT-CAN.

- **KOMBI and CID: Instrument cluster and Central Information Display**

A fault in the RPA or drop in tire pressure will be indicated by the RPA indicator and warning light in instrument cluster.

At the same time, the symbol will light up in the LCD display.

Faults registered by the RPA are indicated as follows by the RPA indicator and warning light (for variations, please refer to **NATIONAL VERSION**):

- The RPA indicator and warning light lights up:

- **Red** (with acoustic signal):

Drop in tire pressure more than approx. 30 % ± 10 %.

Driving safety is no longer guaranteed.

- **Yellow:**

RPA failed

Information about the check control message can be called up in the CID (CID is fitted depending on the vehicle's equipment).

System functions

The Run Flat Indicator (RPA) comprises the following functions:

- Self-test
- Initialization
- Detects drop in tire pressure

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- Visual and acoustic warning
- Actively reduce the load on the defective wheel (E70 only)

Self-test

The RPA performs a self-test when terminal 15 is switched ON. A fault in the RPA is indicated by the RPA indicator and warning light and by a symbol in the LCD display.

Initialization

Initialization is started manually (e.g. by pressing the RPA button). Once it has been started, initialization will continue through to complete calibration. This process may be interrupted any number of times.

It is important that the vehicle is driven away immediately after initialization is started. The system will not start calibration until the vehicle is driven away. Even a terminal change will not change this.

In principle, calibration is only possible while the vehicle is being driven (road speeds above 25 km/h).

Initialization will run as a fully automatic calibration sequence (after the journey has started),. In other words, the circumference of individual tires are recorded and evaluated.

To allow a drop in tire pressure to be detected, the system considers different speed ranges and driving situations. Taking account of the driving situation means that the system has to be primed for each speed range individually.

From 09/2004 (starting with E87), these speed ranges and driving situations have been combined into 3 calibration ranges. This means greater clarity for output via the BMW diagnosis systems Group Tester One (GT1) and DISplus.

The initialization phase lasts approx. 5 to 15 minutes for the individual speed ranges. The end of the initialization phase is not indicated.

A visual and acoustic warning can only be emitted in the speed ranges that have been calibrated by at least 67 percent.

The calibration process can be delayed by:

- dynamic driving
- a road with lots of bends
- frequent changes in load (only on vehicles with electronic height control -> air spring/height control regulation)

Detects drop in tire pressure

The RPA records the wheel speeds using the wheel-speed sensors from the DSC. The RPA compares the speeds of the individual wheels and computes an average speed. In this way the RPA is able to detect a loss of tire pressure. (In the event of a tire losing pressure, the tire rolling circumference of the affected tire is also

reduced.)

Visual and acoustic warning

A drop in pressure in one tire of approx. 30 % $\pm$ 10 % from the initial value is indicated by the RPA indicator and warning light. In addition, an acoustic signal sounds.

Signal output: Depending on the model concerned, either via the instrument cluster or the multi-audio system controller (M-ASK) / Car Communication Computer (CCC).

NOTE: DSC malfunction

The sensors used by the RPA are all monitored by the DSC. If DSC detect a fault, the RPA will also register a malfunction.

Actively reducing load on defective wheel

> E70

If the RPA detects a flat tire on one of the rear wheels, the electronic height control will actively reduce the load on the wheel concerned. The body will then assume a slightly inclined attitude. As soon as the flat tire has been repaired and the RPA reinitialised, the inclined attitude will be levelled out again. No work is needed on the air suspension itself.

Special conditions for system function

The following **driving conditions** may cause a **delay in the warning** being given in the event of a drop in tire pressure:

- Heavy braking
- Rapid acceleration
- High rate of lateral acceleration
- Cornering (in a tight corner)
- Vehicle speed dropping below a minimum speed (the RPA only responds when a certain minimum speed has been reached)
- Large difference in slip (between axles or between wheel on one side of vehicle)
- Initialization not being completed in current speed range (see "Controls")
- Winter conditions
- Heavy changes in load (only vehicles with electronic height control)

The following **operating conditions** may cause a **delay in the warning** being given in the event of a drop in tire pressure:

- Driving with snow chains fitted

Driving with snow chains may impair the correct function of the RPA.

The system will work as normal again after the snow chains have been removed and the vehicle is driven for a few minutes. (Repeat initialization not necessary.)

NOTE: Do not perform initialization when snow chains are fitted.

Initialization and snow chains will cause incorrect adaptation values.

- Trailer towing

Initialization should be performed when a trailer with a weight greater than approx. 300 kg is being towed.

Repeat the initialization process after detaching or unloading the trailer.

- Old/new tires

NOTE: Only fit tires with the same tread depth!

Avoid fitting tires with greatly different tread depth (from approx. 2 millimetres) on one axle. The different diameters mean that the correct operation of the RPA is no longer guaranteed.

The following situations may cause **unnecessary warnings** :

- Initialization not completed after a tire has been replaced (old/new tires, summer/winter tires, change in direction of rotation, or replacement of single defective tire) tire pressures have been changed
- Tires have different levels of wear
- Frequent changes in load (only on vehicles with electronic height control)
- Tires that have not been approved by BMW
- Damaged tires, even if no loss of pressure can be detected (e.g. spin imbalance)
- Tyre has changed slightly during the running-in phase (settling)

In the following cases, the system will **not emit a warning despite a drop in tire pressure being detected** :

- The same amount of pressure is lost in 2 or more tires.
- Drops in tire pressures caused by diffusion and affecting all 4 tires equally
- If a tire is damaged with a sudden loss of all pressure (tire blow-out, warning is given too late)

Operation

The Run Flat Indicator (RPA) is initialized using the following control elements:

- RPA button
- On-board computer button on turn-signal/main-beam switch
- With iDrive in the Central Information Display (CID) with the controller

IMPORTANT: Always perform initialization immediately after correcting the tire pressure, especially if a tire is changed or the wheels are interchanged. Only check tire pressures when the tires are cold.

Set the tires to the correct pressure before performing initialization. During initialization, the set tire pressure is taken as the initial value for the current set of wheels.

Correct the tire pressures when the tires are cold to prevent the data recorded from being affected by temperature.

IMPORTANT: Responsibility resides with the driver at all times

Check tire pressures regularly, at least twice a month and before embarking on lengthy journeys. During initialization, the set tire pressure is taken as the initial value for the current set of tires.

Initialize the RPA in the following situations:

- If tire pressure is changed
(tire pressure is corrected or reset)
- If the position of the tires is changed (change of axles, wheels), even if the tire pressure is not changed
- If a tire is changed or the wheels are interchanged
(e.g. old tires for new tires, summer tires for winter tires, etc.)

Start initialization as follows:

- Terminal 15 ON
(engine OFF or ON, do not pull away)
- Vehicles **with** RPA button
 - Press and hold the RPA button until the RPA indicator and warning light lights up yellow for a few seconds
- Vehicles **with** BC button (on-board computer function)
 - In the on-board computer function select "RPA" and "INIT" (LCD display) with the rocker switch on the turn signal/main-beam switch. Press the BC button to confirm.
 - Press and hold the BC button for approx. 5 seconds, until a box with a tick appears behind the "INIT" display.

> R56:

- In the on-board computer function select "SET/INFO" (LCD display in auxiliary instrument) with the BC button on the turn-signal/main-beam switch.
- Press and hold the BC button until the display changes
- Press the BC button repeatedly until the corresponding symbol and the word "RESET" are displayed.
- Press and hold the BC button until a square with a tick appears.

○ Vehicles with Central Information Display

Initialization is performed via the Central Information Display (CID) and controller.

- Select "RPA" in the "Settings" menu and confirm.
- Select "Set" and confirm.

○ Drive off

The end of the initialization phase is not indicated.

Preconditions for activation

The Run flat Indicator (RPA) is automatically activated when terminal 15 is switched ON. The RPA cannot be switched off manually.

US national version

A flat tire is indicated as follows:

> E53, E83, E85, E86

Yellow RPA indicator and warning light **without** acoustic signal

> E60, E61, E63, E64, E65, E66, E70, E90, E91, E92, E93, R56

Yellow RPA indicator and warning light **with** acoustic signal

An RPA failure is indicated as follows:

- Yellow RPA indicator and warning light **without** acoustic signal

Subject to change.

TIRES WITH EMERGENCY RUNNING CHARACTERISTICS AND TIRE PRESSURE WARNING SYSTEMS

All models

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General information

Warning systems

BMW AG offers two different systems to warn the driver of a drop in tire pressure.

WARNING SYSTEMS SPECIFICATION

System	Description	Measuring principle
RDC	Tyre pressure control	Tyre pressure/temperature
RDW	Tyre pressure warning	Comparison of wheel speeds

Emergency running systems

In addition to the warning systems, two emergency running systems are also employed to prevent a depressurized tire from caving in:

Components of emergency running system with self-supporting tires:

EMERGENCY RUNNING SYSTEMS SPECIFICATION (SELF-SUPPORTING TIRES)

RDW (standard equipment)	Tyre pressure warning
RDC (available as option from 03/2000)	Tyre pressure control
SST	Self Supporting Tire
EH2 disc wheel	Disc wheel with Extended Hump 2

Components of emergency running system with integrated support ring:

EMERGENCY RUNNING SYSTEMS SPECIFICATION (INTEGRATED SUPPORT RING)

Support ring	NOTE: In the future, only for heavy safety vehicles (E38/3)
RDC (optional)	Tyre pressure control
H2 disc wheel	Standard disc wheel with Hump 2

Tyre pressure control (RDC)

RDC system description

RDC permanently monitors the tire pressure and the temperature in the tires, both while the vehicle is being driven and when it is stationary. Data is transmitted via data telegram by the wheel electronic units to the antennas installed in the wheel housing and on to the RDC control unit. There, the data received is compared with the stored limit values.

After correcting the air pressure with the engine off and the ignition on, press the Set button and hold (approx. 6 seconds) until the words "Set tire pressure" appear in the instrument cluster (instrument cluster high) or the yellow LED lights up (basic instrument cluster).

If the limit values are exceeded, the driver will be warned via the instrument cluster in two stages, as follows:

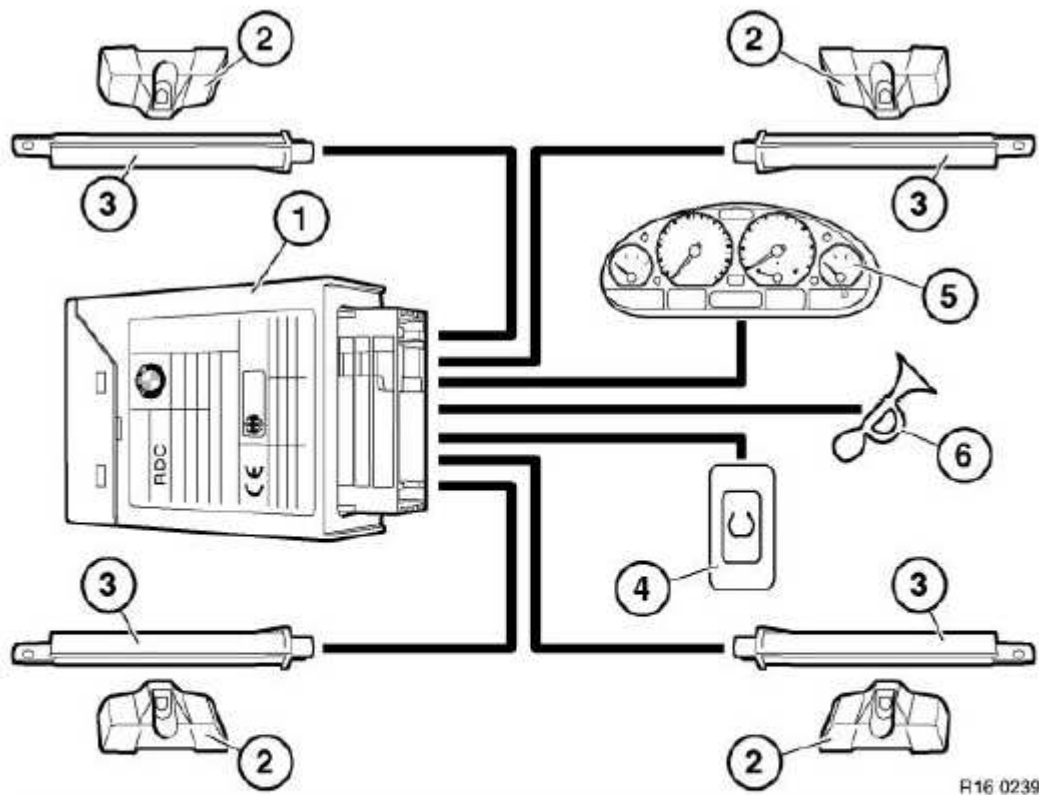
TYRE PRESSURE SPECIFICATION

Loss of tire pressure	Warning
Drop in tire pressure of 0.2 to 0.4 bar	Yellow LED on basic instrument cluster or Text: "Check tire pressure" on instrument cluster high Gong: no
Drop in tire pressure of more than 0.4 bar	Red LED on basic instrument cluster or Text: "Tyre failure" on instrument cluster high Gong: yes

Advantages of RDC**ADVANTAGES OF RDC**

1. Safety	○ early warning in the event of rapid loss of pressure ○ warning of loss of tire pressure through normal diffusion
2. Comfort	○ unchanging ride comfort ○ instruction to check tire pressure as necessary
3. Service life, economy	○ minimization of tire wear ○ minimization of fuel consumption
4. New developments	○ allow tires with emergency running characteristics to be fitted ○ no spare wheel if tires with emergency running characteristics are fitted (saves weight)

RDC system layout



- | | |
|--|-------------------------------|
| (1) RDC control unit | (4) Set button |
| (2) Wheel electronic units (4 off) | (5) Display element |
| Wheel electronic unit for spare wheel (optional) | (6) Anti-theft warning system |
| (3) Receiving antennas (4 off) | - Wiring harness |

Fig. 27: RDC System Layout

Courtesy of BMW OF NORTH AMERICA, INC.

Component description

RDC control unit

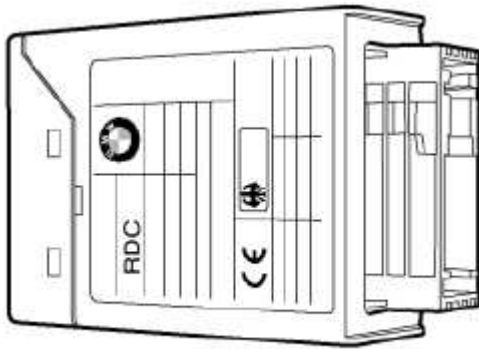
Fully diagnosis-compatible

Task:

evaluates the following telegrams from the wheel electronic units:

- tire pressure
- tire air temperature
- identification number (ID) of wheel electronic unit
- remaining service life of wheel electronic unit battery

If required, information or a warning is transmitted.



R16 0240

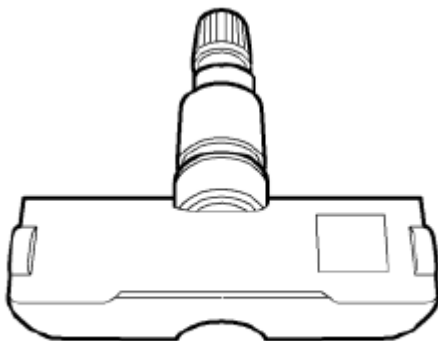
Fig. 28: RDC Control Unit

Courtesy of BMW OF NORTH AMERICA, INC.

Wheel electronic unit with valve

Components:

- pressure sensor
- temperature sensor
- transmitter
 - frequencies according to country
- power supply
- service life: approx. 7 years
- not exchangeable



R16 0241

Fig. 29: Wheel Electronic Unit With Valve

Courtesy of BMW OF NORTH AMERICA, INC.

Installation location of wheel electronic unit in disc wheel

The wheel electronic unit (1) is screwed to the valve (2) on the disc wheel (3)

Identifying feature:

metal tire valves

NOTE: Different valves have to be used to allow for the different disc wheel sizes. The valves are color-coded. The correct coding can be taken from the spare parts catalogue.

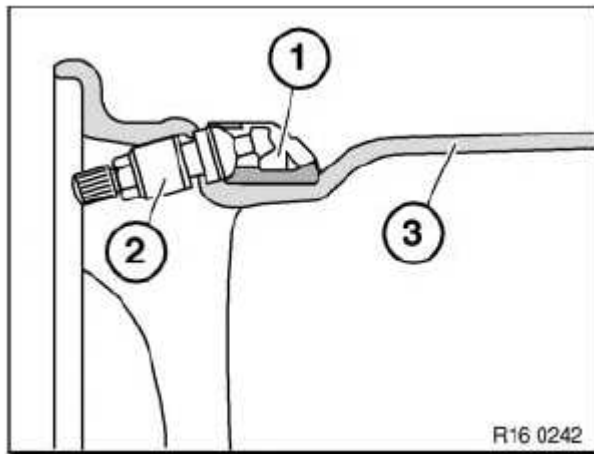


Fig. 30: Wheel Electronic Unit Installation Location In Disc Wheel
Courtesy of BMW OF NORTH AMERICA, INC.

Antenna

There is an antenna in each wheel housing.

Task:

receives telegrams and forwards these to the RDC control unit.

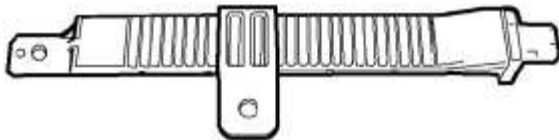


Fig. 31: Antenna
Courtesy of BMW OF NORTH AMERICA, INC.

Component description

Set button

Installed in the instrument panel to the right of the steering wheel. (E46: in the center console)

Symbol: tire cross-section

Task:

initialization after resetting cold tire pressure or after changing tire or wheel location.

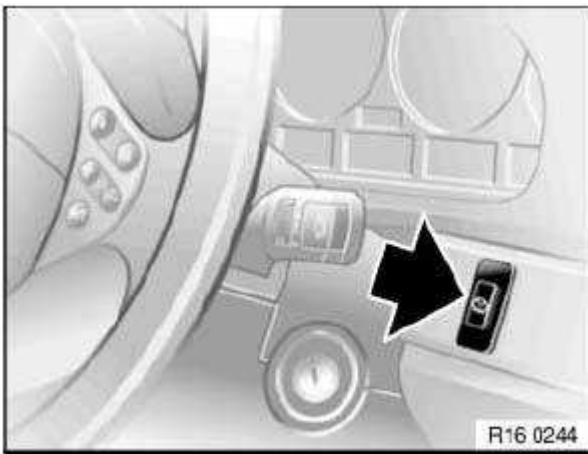


Fig. 32: Locating Set Button

Courtesy of BMW OF NORTH AMERICA, INC.

Display element in instrument cluster

Indicator lamp lights up yellow:

- drop in tire pressure of 0.2 to 0.4 bar

Indicator lamp lights up red:

- drop in tire pressure greater than 0.4 bar

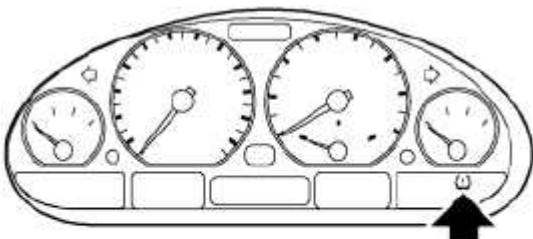


Fig. 33: Locating Display Element In Instrument Cluster
Courtesy of BMW OF NORTH AMERICA, INC.

Tyre pressure warning RDW

RDW system description

RDW measures the wheel speeds on all four wheels, using the wheel speed sensors of the ABS/ASC or ABS/DSC system. It compares the wheel speeds of the diagonally opposite wheels and of the average speed.

In the event of a drop in tire pressure, the dynamic diameter of a wheel will change, leading to a changed wheel speed.

A drop in tire pressure of $30 \pm 10\%$ can be detected on all wheels from about 15 km/h (10 mph) up to the vehicle's top speed.

If this value is exceeded, the driver will be warned via the instrument cluster as follows:

TYRE PRESSURE SPECIFICATION

Loss of tire pressure	Warning
Red LED Text: "Tyre failure" Gong: yes	
Loss of tire pressure of $30 \pm 10\%$	The vehicle is not to be driven faster than 80 km/h (50 mph).
	NOTE: A cautious driving style with moderate forward and transverse acceleration will help to prolong the service life of the defective tire.

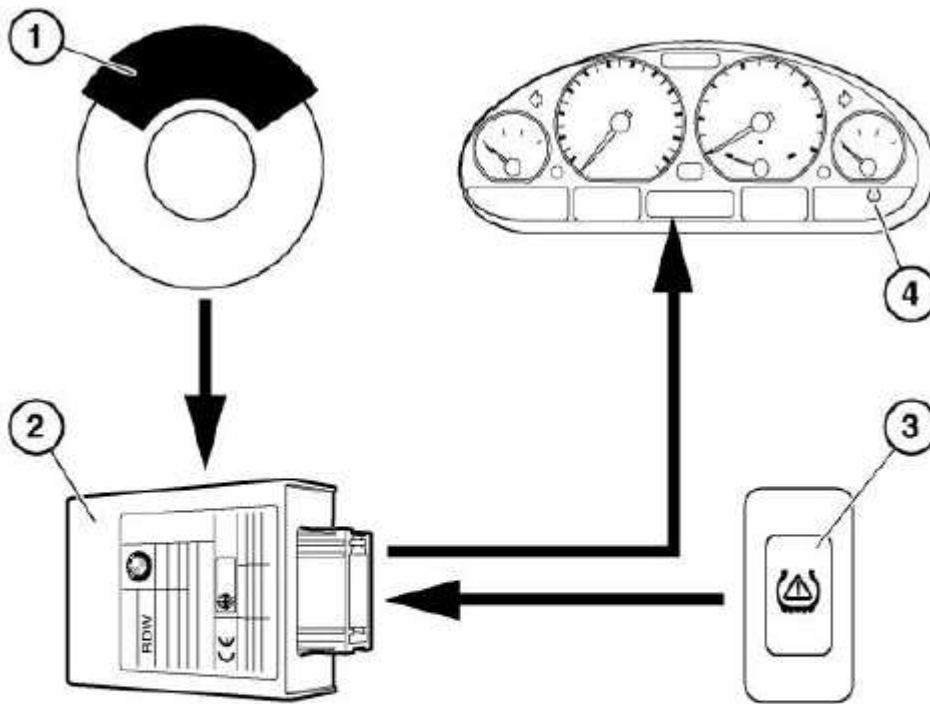
Advantages of RDW

With two exceptions, the advantages of RDC also apply to RDW.

Exceptions:

- no warning of loss of tire pressure through normal diffusion
- tire pressure still have to be checked regularly, every 14 days

RDW system layout



R16 0246

(1) Wheel speed sensors of ABS/ASC or ABS/DSC system

(3) Set button

ASC = Automatic Stability Control
DSC = Dynamic Stability Control

(4) Display element

(2) RDW control unit

- Wiring harness

Fig. 34: RDW System Layout

Courtesy of BMW OF NORTH AMERICA, INC.

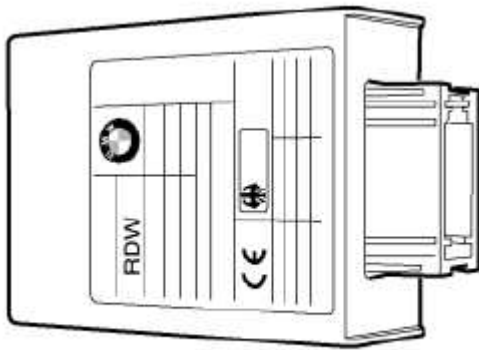
Component description

RDW control unit

Fully diagnosis-compatible

Task:

- evaluates wheel speeds.
- a warning is transmitted as required.



R16 0247

Fig. 35: RDW Control Unit

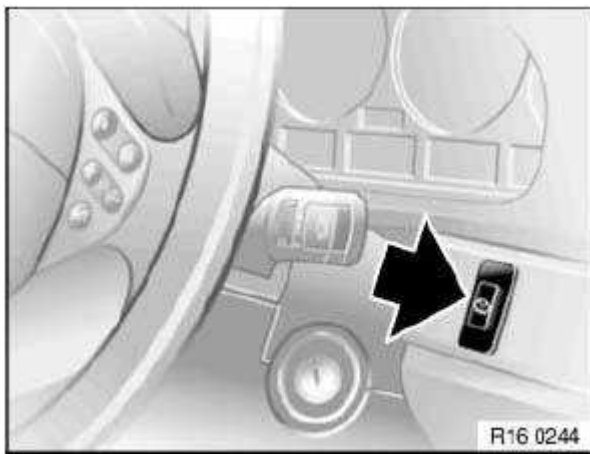
Courtesy of BMW OF NORTH AMERICA, INC.

Set button

Installed in the dashboard to the right of the steering wheel. Symbol: tire cross-section with warning triangle

Task:

initialization after resetting cold tire pressure or after changing tire or wheel location.



R16 0244

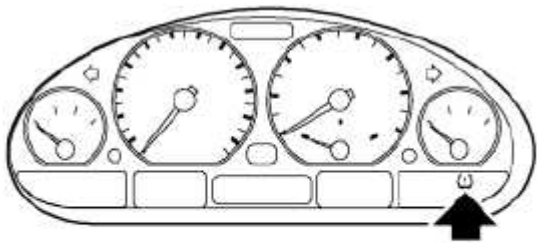
Fig. 36: Locating Set Button

Courtesy of BMW OF NORTH AMERICA, INC.

Display element in instrument cluster

Indicator lamp lights up red:

- drop in tire pressure $30 \pm 10 \%$



R16 0245

Fig. 37: Locating Display Element In Instrument Cluster
Courtesy of BMW OF NORTH AMERICA, INC.

Emergency running systems

Introduction

Tires with emergency running characteristics can still be used for a certain distance even if they suffer a complete loss of pressure. There are two different systems which meet these requirements:

- emergency running system with self-supporting tires
- emergency running system with integrated support ring

Emergency running systems setup

Emergency running system with self-supporting tires

The side walls of the self-supporting tire are reinforced. In conjunction with a special disc wheel, the tire can still be used for a certain distance even if it suffers a complete loss of pressure.

Mobility is retained for the following distances up to a speed of 80 km/h (50 mph) and with a cautious, suitably adapted driving style:

Unloaded vehicle max. 500 km (300 miles)

Unloaded roadster less than 250 km (150 miles)

Fully loaded vehicle max. 50 km (30 miles)

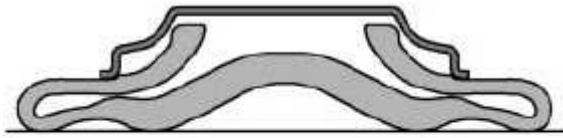
Self-supporting tires demand permanent monitoring of the tire pressure to ensure that the driver is given adequate warning if pressure is lost during a journey. For this reason, these tires are only available in conjunction with the warning system RDW and from 03/2000 also with RDC.

To prevent the self-supporting tires from becoming detached from the disc wheel in the event of a complete loss of tire pressure, they must be fitted to newly developed wheels with modified disc wheel humps, but with unchanged tire seating (= standard disc wheel).

However, the new wheels can also be used for standard tires of the same size.

Comparison standard tires / self-supporting tires

Standard tires, unpressurised

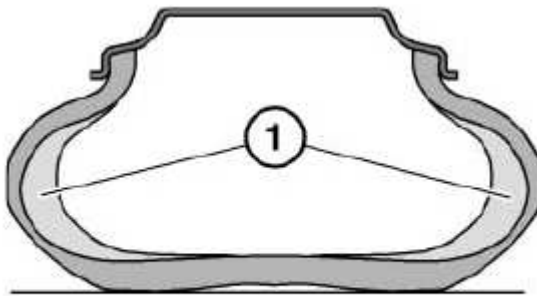


R16 0248

Fig. 38: Unpressurised Standard Tires
Courtesy of BMW OF NORTH AMERICA, INC.

Self-supporting tires, unpressurised

Envulcanised reinforcement (1) made of a temperature-resistant rubber compound.



R16 0249

Fig. 39: Unpressurised Self-Supporting Tires
Courtesy of BMW OF NORTH AMERICA, INC.

Disc wheels

H2 disc wheel (standard disc wheel) for emergency running system with integrated support ring

1. Hump 2 of standard disc wheel

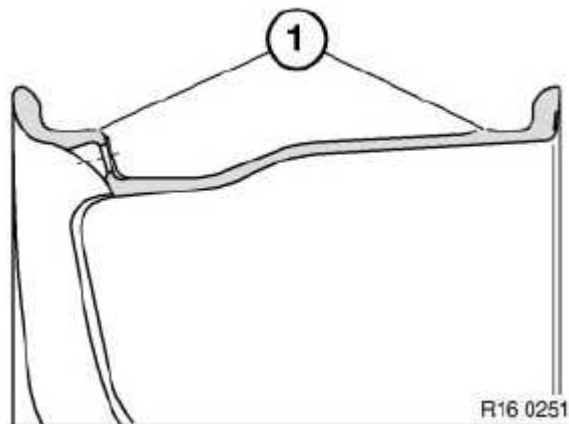


Fig. 40: H2 Disc Wheel For Emergency Running System With Integrated Support Ring
Courtesy of BMW OF NORTH AMERICA, INC.

EH2 disc wheel for emergency running system with self-supporting tire

1. Extended Hump 2 of disc wheel
2. Drop center relocated a few millimetres to the center (precentring on outside)

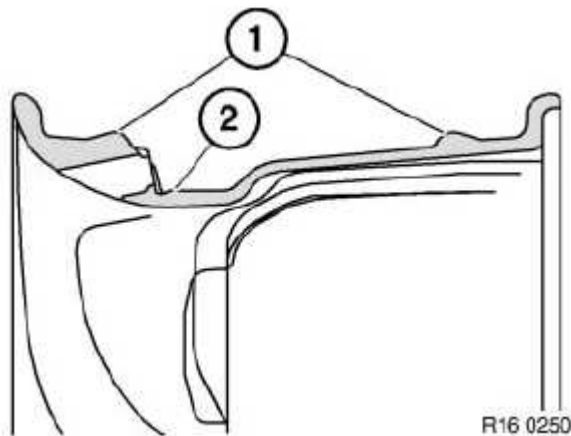


Fig. 41: EH2 Disc Wheel For Emergency Running System With Self-Supporting Tyre
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: The new EH2 disc wheels (extended Hump 2 inner and outer) will be used more frequently on BMW vehicles in the future as they can also help to delay standard tires from being lost in the event of a drop in tire pressure.

Example: from current 1.1 bar to 0.6 bar (X5 or Landrover disc wheel)

Emergency running system with integrated support ring

(In the future, primarily on heavy safety vehicles)

The support ring is made of a high-strength resilient plastic and is fitted on the disc wheel inside the tire. The support ring can only be removed using special tools which have been specially approved by BMW. It can only be removed after destroying the tire.

Emergency running systems with integrated support ring are used in particular on heavy safety vehicles. They allow the vehicle to be driven away from a potential danger without dropping speed even if the tires have suffered a complete loss of pressure (flight situation).

It is possible as an option to have the tire pressure monitored by an RDC system. The RDC is installed by pressing the components into the support ring before it is fitted.

Wheel structure with integrated support ring

Emergency running system with integrated support ring

1. Tyre
2. Support ring

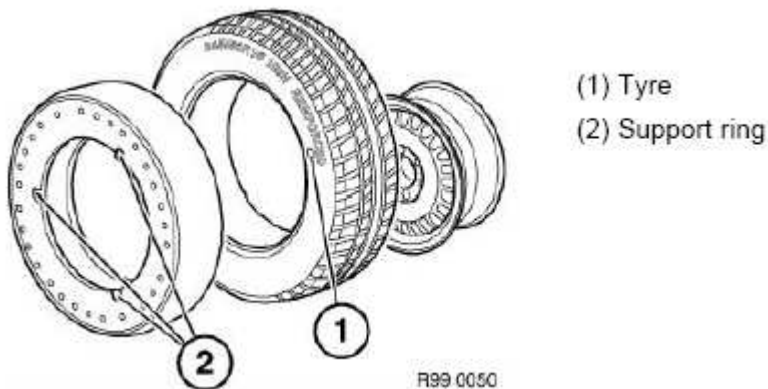


Fig. 42: Emergency Running System With Integrated Support Ring
Courtesy of BMW OF NORTH AMERICA, INC.

Installation location of RDC wheel electronic unit

1. Wheel electronic unit
2. Support ring

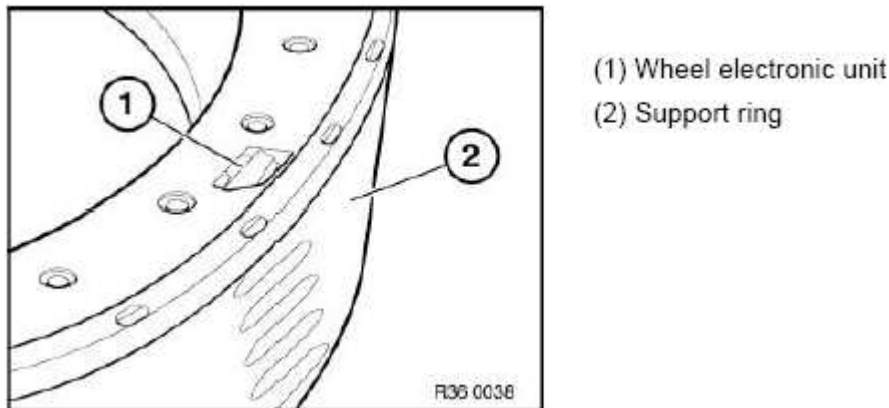


Fig. 43: RDC Wheel Electronic Unit Installation Location

Courtesy of BMW OF NORTH AMERICA, INC.

For further information on the subject of "Tyre pressure warning systems and tires with emergency running characteristics", please refer to the vehicle Owner's Handbook.

A Parts Information bulletin will be published with information on how to order parts.

Functional and system descriptions are not subject to change. Parts availability and immediate ordering availability cannot be derived from this information. The specialized departments will inform the markets with further details at the appropriate time.

STORING WHEELS AND TIRES

all models

Wheels / tires-general notes

The service of storing a customer's wheels is one which is now almost taken for granted. For this reason, we have published this BMW Technical Service bulletin to provide a uniform storage concept, which will prevent damage being caused due to incorrect storage.

The tire's rubber will age under the influence of sunlight, heat, humidity, movements in the air and ozone, and will thus lose some of its stability and elasticity. For this reason, tires should never be stored in the open-air. If open-air storage cannot be avoided, the wheels / tires must be stored in a clean and dry condition and covered with waterproof material. It is essential that wheels / tires are protected against rain, snow and sunlight, but due to the risk of corrosion they must not be stored in tire sacks. For more information on protective covers for wheels and tires.

Wheels / tires with tire pressure control (RDC) must not be cleaned with high-pressure cleaning equipment. For general information on RDC.

Storage requirements

The following requirements apply in general to storage in enclosed rooms:

2008 MINI Cooper

2007 SUSPENSION Wheel and tires - SI Techniques - Cooper

STORAGE REQUIREMENTS

cool	15...25 °C / sources of heat screened, or 1 m minimum distance from source of heat
dry	Prevent water and condensation Avoid contact with mineral lubrication products
dark	Protect from direct sunlight and high-UV artificial light
moderate ventilation	Avoid a supply of oxygen and ozone

In short, the storage room should be cool and dry. It is not necessary to heat the room during the winter. In the summer, the doors and windows should be kept closed to ensure that no air can circulate. In addition, the windows can also be coated with sun protection paint.

The storage room should not contain any working electric machinery, welding equipment, distribution boxes etc. as electrical sparks generate ozone which can have a serious impact on the surface of the tire (ozone cracks).

Tires should not be allowed to come into contact with oil, petrol, or other mineral lubricants as these dissolve rubber, making the tire porous.

Preparing wheels / tires

1. Before removing a wheel, mark its position on the vehicle.
2. Whenever possible, keep the tire on its wheel (complete wheels).
3. Correct the inflation pressure and recheck every 2 months.
4. Ensure that tires are stored at a sufficient distance above the ground. Wheels / tires should never be stored on the ground.
5. Complete the storage forms. These should contain the following data:
 - Type and size of tire
 - Condition and tread depth
 - Customer's address
 - Date and signature of customer

Wheel / tire storage requirements

A. Tyre fitted to wheel

Do not store upright, ...

NOTE: If storing the wheels upright cannot be avoided, the inflation pressure must be increased to 3.5 bar.

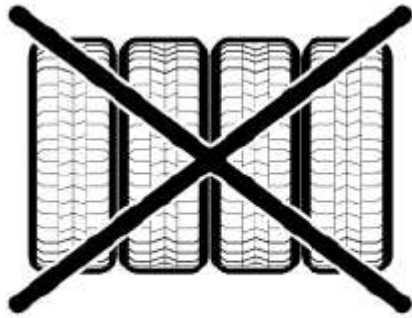
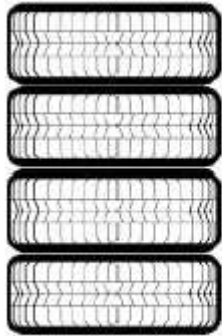


Fig. 44: Precaution For Storing Wheels And Tires - Do Not Store Upright
Courtesy of BMW OF NORTH AMERICA, INC.

Fig. 45: Precaution For Storing Wheels And Tires - Rather Hang
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Never store tires on the ground.
Use a wooden pallet or similar.

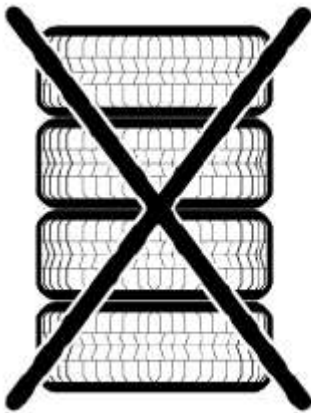


S36 99 003

Fig. 46: Precaution For Storing Wheels And Tires - Stack
Courtesy of BMW OF NORTH AMERICA, INC.

C. Tires not fitted

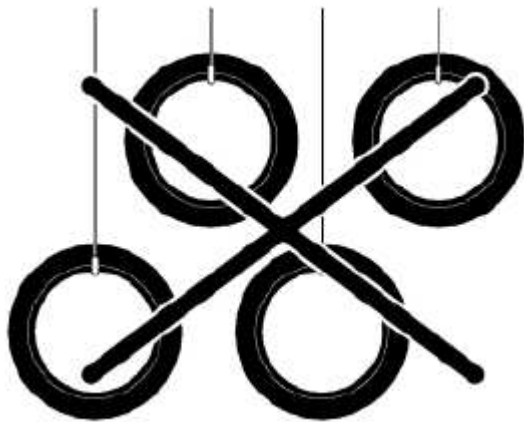
Do not stack, ...



S36 99 004

Fig. 47: Precaution For Storing Wheels And Tires - Do Not Stack
Courtesy of BMW OF NORTH AMERICA, INC.

... do not hang, ...

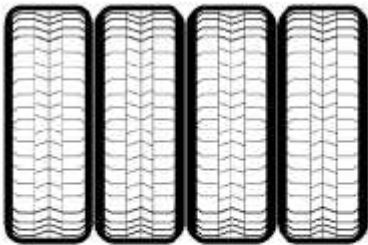


S36 99 005

Fig. 48: Precaution For Storing Wheels And Tires - Do Not Hang
Courtesy of BMW OF NORTH AMERICA, INC.

... but rather store them upright and turn them every 4 weeks.

NOTE: **Never store tires on the ground.**
 Use commercially available shelves.



S36 99 006

Fig. 49: Precaution For Storing Wheels And Tires - Store Upright
Courtesy of BMW OF NORTH AMERICA, INC.